Attachment H

Proposal # 2001- A-204 (Office Use Only)

PSP Cover Sheet (Attach to the front of each proposal)

Proposal Title: Using Benthic Macroinvertebrate Communities for Assessment of Adaptive Management actions in Streams Supporting Anadromous Salmonids

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Amount of funding requested: $2,860,496

Some entities charge different costs dependent on the source of the funds. If it is different for state or federal funds list below.

State cost _____ Federal cost _____

Cost share partners? ___ **Yes** X **No**

Identify partners and amount contributed by each _____

Indicate the Topic for which you are applying (check only one box).

- [X] Natural Flow Regimes
- [ ] Nonnative Invasive Species
- [ ] Channel Dynamics/Sediment Transport
- [ ] Flood Management
- [ ] Shallow Water Tidal/ Marsh Habitat
- [ ] Contaminants
- [ ] Beyond the Riparian Corridor
- [ ] Local Watershed Stewardship
- [ ] Environmental Education
- [ ] Special Status Species Surveys and Studies
- [ ] Fishery Monitoring, Assessment and Research
- [ ] Fish Screens

What county or counties is the project located in? 21 counties, see list on next page

What CALFED ecozone is the project located in? See attached list and indicate number. Be as specific as possible 3, 4, 5, 7, 8, 9, 11, 12, 13

Indicate the type of applicant (check only one box):

- [ ] State agency
- [ ] Public/Non-profit joint venture
- [ ] Local government/district
- [ ] University
- [ ] Other: _____
- [X] Federal agency
- [ ] Non-profit
- [ ] Tribes
- [ ] Private party

Attachment H1: List of counties where sampling may occur.

Amador County
Butte County
Calaveras County
Colusa County
El Dorado County
Fresno County
Glenn County
Madera County
Mariposa County
Merced County
Nevada County
Placer County
Sacramento County
San Joaquin County
Shasta County
Stanislaus County
Sutter County
Tehama County
Tuolumne County
Yolo County
Yuba County

Indicate the primary species which the proposal addresses (check all that apply):

- ☐ San Joaquin and East-side Delta tributaries fall-run chinook salmon
- ☐ Winter-run chinook salmon
- ☐ Late-fall run chinook salmon
- ☐ Delta smelt
- ☐ Splittail
- ☐ Green sturgeon
- ☐ White Sturgeon
- ☐ Waterfowl and Shorebirds
- ☐ Migratory birds
- ☐ Other listed T/E species: _____
- ☐ Spring-run chinook salmon
- ☐ Fall-run chinook salmon
- ☐ Longfin smelt
- ☐ Steelhead trout
- ☐ Striped bass
- ☐ All chinook species
- ☒ All anadromous salmonids
- ☐ American shad

Indicate the type of project (check only one box):

- ☒ Research/Monitoring
- ☐ Pilot/Demo Project
- ☐ Full-scale Implementation
- ☐ Watershed Planning
- ☐ Education

Is this a next-phase of an ongoing project? Yes ___ No X
Have you received funding from CALFED before? Yes ___ No X

If yes, list project title and CALFED number _____

Have you received funding from CVPIA before? Yes ___ No X

If yes, list CVPIA program providing funding, project title and CVPIA number (if applicable):

_____

By signing below, the applicant declares the following:

- The truthfulness of all representations in their proposal;
- The individual signing the form is entitled to submit the application on behalf of the applicant (if the applicant is an entity or organization); and
- The person submitting the application has read and understood the conflict of interest and confidentiality discussion in the PSP (Section 2.4) and waives any and all rights to privacy and confidentiality of the proposal on behalf of the applicant, to the extent as provided in the Section.

Larry R. Brown
Printed name of applicant

Larry R. Brown
Signature of applicant

B. Executive Summary: Using Benthic Macroinvertebrate Communities for Assessment of Adaptive Management Actions in Streams Supporting Anadromous Salmonids

Amount requested: $2,860,496

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Human activities have altered the hydrology and consequently the ecology of Central Valley streams and rivers, often with negative effects on anadromous salmonids. CALFED proposes to restore some improved level of ecological function to such streams through various adaptive management actions, including manipulation of flow regimes. However, there is presently no measure of stream ecological condition available for the assessment of the success of such actions other than monitoring of chinook salmon populations on some streams. Chinook salmon and other anadromous fish are not sufficient as the single indicator of stream ecological condition because they spend a considerable portion of their life cycle outside of the stream ecosystem. Stream macroinvertebrates, which inhabit the stream for their entire life cycle, may be the best available indicator of stream condition. Monitoring of stream macroinvertebrate communities is a proven and well-established technique in other areas of the United States and various studies in California indicate that the method will work in Central Valley streams.

The major objective of this proposal is to document the present condition of macroinvertebrate communities in Central Valley streams that support populations of anadromous salmonids and are likely candidates for stream protection or restoration actions. This objective will be achieved by sampling 116 sites on the San Joaquin and Sacramento rivers and 16 tributary streams for each of three years. In addition to sampling the macroinvertebrates, detailed habitat and water quality measurements will be done at each site. These data will allow for testing of three hypotheses implicit in the major objective:

1. Stream macroinvertebrate communities are accurate indicators of ecological conditions in Central Valley streams.
2. Stream macroinvertebrates can be used to compare ecological conditions between streams.
3. Stream macroinvertebrate communities are responsive to changes in ecological conditions.

Successful adaptive management requires assessment tools to determine if adaptive management actions are having the desired effects. Studies conducted outside of California and within the Central Valley show that stream macroinvertebrate communities respond to environmental conditions. This study will demonstrate the utility of monitoring stream macroinvertebrate communities as a tool for assessment of flow regime modifications and other stream restoration actions. The results of this study can also serve as baseline data for existing conditions in the streams sampled and as a regional characterization of existing ecological conditions that can be used to put site-specific macroinvertebrate sampling results into a regional context. The goals of CALFED and biological principles of CVPIA recognize that the restoration and maintenance of streams in good ecological condition is desirable for supporting healthy populations of anadromous fishes and other organisms dependent on stream habitats. Monitoring stream macroinvertebrate communities may be a useful indicator for determining whether management actions, in fact, improve stream condition or if other actions are required.

C. Project Description

C1. Statement of the Problem

C1a. Problem: Human activities have altered hydrologic processes in the Bay-Delta ecosystem and these changes have had negative impacts on stream ecosystems, including special-status fish species such as chinook salmon and steelhead (CALFED 2000, PSP Section III, page 23). Consideration of the economical and social realities of water allocation in California has led CALFED to suggest that improvement of ecological conditions will not be attained by restoration of pre-disturbance natural flow regimes but by mimicking historical peak flows and other features of the natural hydrograph to restore the highest measure of ecological function possible with the resources (water) available (CALFED 2000, PSP Section III, page 24). Given the considerable uncertainty involved in such adaptive management projects CALFED has requested additional research, monitoring, modeling, planning and feasibility studies to aid CALFED planning efforts (CALFED 2000, PSP Section III, pages 24-25). One aspect of adaptive management implied in the list, but not explicitly identified, is the need to establish methods of assessing the success of adaptive management actions.

Although CALFED is approaching stream restoration from the perspective of physical, geomorphic processes, the success of such restoration will almost certainly not be judged on the basis of physical measurements. The CALFED Ecosystem Restoration Program Strategic Goals all involve protection or restoration of ecological communities, habitats, or particular groups of organisms (CALFED 2000, PSP Section III, pages 17-21). It seems likely that in the absence of new monitoring programs, success of stream restoration efforts will be based largely on the responses of presently monitored chinook salmon populations. Without discussing the many logistic difficulties involved with monitoring chinook salmon in Central Valley streams, chinook salmon are not appropriate as the sole assessment end point or indicator of stream ecological function. Anadromous fishes (by definition) do not spend the entire year in Central Valley streams, spending a considerable portion of their life cycle outside of the stream ecosystem (Fig. 1). Therefore, salmon populations will be affected by ecological conditions in habitats other than the streams of interest. Other habitats include streams confluent with the stream of interest, the Delta, Suisun Bay, San Francisco Bay, and the Pacific Ocean. It is conceivable that stream restoration actions could significantly improve stream ecological conditions with chinook salmon showing no measurable response because of conditions in the Delta, San Francisco Bay, or the Pacific Ocean. In this case, stream restoration could be declared a failure (and a waste of considerable funds) based on chinook salmon populations. Conversely, CALFED will likely be implementing actions in multiple rivers and the Delta at the same time so that salmon populations in a particular stream may increase in response to downstream actions even though the ecological conditions in the stream are not substantially improved, possibly at considerable cost in water. Assessment of the success of stream restoration actions should include evaluations based on organisms that are resident in the stream for the entire year.

Development of stream bioassessment procedures has generally focused on one of three groups of organisms—fish (e.g. Karr 1981, Fausch et al. 1984, Hughes and Gammon 1987, Barbour et al. 1999), benthic macroinvertebrates (e.g. Fore et al. 1996, Barbour et al. 1999), or benthic algae (e.g. Barbour et al. 1999, Stevinson and Pan 1999, Hill et. al. 2000). In Central Valley streams, monitoring of fishes is conceptually attractive because juveniles of several special-status anadromous fishes (steelhead and spring-run salmon) may spend at least one entire

year in streams, protection and conservation of native fish communities is a CALFED goal, and there are previous studies of how resident stream fishes respond to variation in flow and other environmental conditions (Brown and Moyle 1993, Brown 2000, Marchetti and Moyle, in press, Brown and May, U.S. Geological Survey, written communication). However, fish bioassessments require capture of fishes for identification to species. Capturing fish can cause physiological stress and, in some cases, mortality. Capture of special-status species requires special permits and regulatory agencies are sensitive to studies that can cause harm to the species they protect, resulting in restrictions on sampling methods, locations, and times.

Collection of benthic algae requires no special permits; however, identification of algae species is a very specialized field and there are relatively few laboratories that do such analyses. Also, relatively little is known about benthic algae communities of Central Valley streams (Brown 1997).

Collection of stream benthic macroinvertebrates only requires a California Scientific Collecting permit. There are a number of existing laboratories that can successfully process samples and identify California stream benthic macroinvertebrates. There is a growing body of information regarding Central Valley stream macroinvertebrates, some of it published (Leland and Fend 1998, Brown and May, in press) and some in unpublished reports (Jim Harrington, California Department of Fish and Game, personal communication). Monitoring of stream benthic macroinvertebrate communities, alone or in combination with monitoring of other stream biota, would be a useful tool for assessing the response of stream ecosystems to manipulations of flow regimes and other restoration activities.

CALFED references the value of monitoring stream benthic macroinvertebrates to assess individual projects at several points in Section III of the PSP (CALFED 2000); however, regional monitoring can serve as a framework for comparisons of ecological conditions within and between streams and to characterize existing conditions in California streams so that changes can be documented (Fig. 2). Further, such a framework will be useful when considering the regional importance of responses observed during site-specific monitoring.

The major objective of this proposal is to document, using standard protocols, the present condition of macroinvertebrate communities in Central Valley streams that support populations of anadromous salmonids and are likely candidates for stream protection or restoration actions. This will allow comparisons of ecological conditions within and between streams and provide a point of reference so that the ecological consequences of flow manipulation (or other stream restoration actions) can be assessed. To achieve this major objective several sub-objectives should be achieved.

1. Establish and apply standardized protocols for sampling of stream macroinvertebrates in wadeable and non-wadeable streams. Calibrate the two protocols to the extent possible so that wadeable and non-wadeable sites can be compared.
2. Measure habitat and water quality variables at each site sampled so that patterns in stream macroinvertebrate community structure can be related to environmental conditions.
3. Conduct sampling at the same sites over three years so that the responses of the macroinvertebrate communities to variability in flow or other environmental conditions can be documented to the extent possible.
4. Test various single and combined measures (metrics or indicators) of stream macroinvertebrate community structure that could be used to construct an index of stream condition.

C1b. Conceptual model: General conceptual models for understanding community structure of stream macroinvertebrate communities already exist. The River Continuum Concept (Vannote et al. 1980) is a conceptual model of how stream macroinvertebrate communities change in response to ecological gradients from small headwater streams to large rivers. The River Continuum Concept includes effects of tributary streams but does not explicitly consider human perturbations. The Serial Discontinuity Hypothesis specifically addresses the potential effects of dams and reservoirs on patterns expected under the River Continuum Concept (Ward and Stanford 1983, Ward and Stanford 1995). Basically, by disturbing energy and material flux from upstream to downstream, dams reset the River Continuum to a different state followed by gradual recovery of natural processes and community structure in downstream stream reaches. Conceptual frameworks for evaluating the usefulness of metrics and constructing indexes of stream condition are also well developed (Hughes et al. 1998, Karr and Chu 1998). A conceptual model for how these various existing conceptual models will be utilized in the present project is presented in Figures 1 and 2.

C1c. Hypotheses being tested: The major hypothesis being tested is contained within the major objective of the study stated in section C1a. This objective can be restated as the following hypotheses.

1. Stream macroinvertebrate communities are accurate indicators of ecological conditions in Central Valley streams that support populations of anadromous salmonids. Data requirements for this hypothesis are abundances of stream macroinvertebrates and measures of habitat and chemical conditions at each site sampled.
2. Stream macroinvertebrate communities can be used to compare ecological conditions between streams. Data requirements are the same as for hypothesis #1 but this hypothesis also requires that all data are collected from all sites on all streams with standardized protocols.
3. Stream macroinvertebrate communities are responsive to changes in environmental conditions and can be used to assess the ecological consequences of flow manipulation (or other stream restoration actions). This hypothesis requires collecting data across a range of environmental variability that encompasses the environmental conditions anticipated to occur as a result of stream restoration actions. Because this proposal does not include actual manipulation of flow regimes we propose to address this hypothesis by sampling multiple sites on a wide array of anadromous fish streams in each of three years. Because water management strategies and precipitation vary from year to year and from stream to stream we should capture the responses of stream macroinvertebrate communities to a wide range of environmental conditions but cannot guarantee that we will capture the entire range of environmental conditions that will occur under a particular adaptive management design.

CALFED Goals 1, 2, and 4 and the biological principles of the CVPIA all identify restoration of ecological functions as the mechanism for enhancing at-risk species and as a desirable goal in itself. Neither plan specifically identifies a useful biological indicator of ecological conditions in streams. This proposal will establish relationships between physical and chemical conditions in streams that will indicate if monitoring stream macroinvertebrate communities can be used as an indicator of environmental conditions in streams. Also, the structure of macroinvertebrate communities, through analysis of trophic structure (feeding

relationships), provides useful information on energy transfer and productivity of stream ecosystems.

C1d. Adaptive Management: This proposal relates to several steps in the adaptive management process (CALFED 2000, PSP Section III, Figure 2, page 15). In most respects this project can be considered targeted research to improve understanding of the effects of flow manipulations and other stream restoration actions on stream ecosystems. However, it can also serve as a pilot design for a stream monitoring network for assessing the effectiveness of stream restoration actions in improving ecological conditions. In this latter context, this project will provide a database of initial conditions for anadromous fish streams likely to be selected for stream restoration actions.

For reason already discussed in section C1a of this proposal (also see Fig. 1), monitoring of anadromous fishes should not be the only biological indicator employed in assessing the success of stream restoration actions, including manipulation of flow regimes. Benthic macroinvertebrates would serve as a better indicator for monitoring because they reside in the stream through the entire year. Consequently, stream macroinvertebrates will allow more accurate assessment of restoration of ecological processes that occur throughout the year. It is also worth noting that adults and larvae of stream macroinvertebrates (primarily insects) serve as an important food source for young fish of all species.

The choice of correct indicators is critical to the adaptive management process (CALFED 2000, PSP Section III, Figure 2). The response of the indicator determines whether an adaptive management action should be continued, modified, or curtailed. We suggest a system-wide sampling program rather than a site specific or pilot program for several reasons. First, the protocols we propose to use have already been used successfully in California (Brown and May, in press, Jim Harrington, California Department of Fish and Game, written communications). Second, published studies already indicate that California Central Valley stream benthic macroinvertebrate communities are responsive to environmental conditions (Leland and Fend 1998, Brown and May in press). Finally, a system-wide study using standard techniques will provide a baseline useful to subsequent site-specific studies and provide an incentive for adoption of the protocols as standard practice for CALFED projects. Only by using the same protocols will results from different studies be comparable across space and time.

C2. Proposed Scope of Work

C2a. Location and/or Geographic Boundaries of the Project: The proposed study area is shown in Figure 3. The map provided (Fig. 3) is not at any of the scales requested in the PSP because of the extent of the proposed study area and because specific sites have not been selected. When sites have been selected they will be mapped on USGS quad maps (1:24,000) and copies can be provided to CALFED. Because this project involves multiple sites that have not all been selected, we do not provide a "centroid" or equivalent at this time as requested in the PSP. Such a centroid will be supplied pending final site selection and a CALFED decision that such a measure is desirable for this type of multiple-site research/monitoring project.

This project potentially includes sampling activities in 21 counties (Amador, Butte, Calaveras, Colusa, El Dorado, Fresno, Glenn, Madera, Mariposa, Merced, Nevada, Placer, Sacramento, San Joaquin, Shasta, Stanislaus, Sutter, Tehama, Tuolumne, Yolo, and Yuba). Ecozones (specific streams or reaches in parentheses) potentially included in the project area are

3-Sacramento River (Keswick Dam to Sacramento), 4-North Sacramento Valley (Clear Creek and Battle Creek), 5-Cottonwood Creek, 7-Butte Basin (Mill Creek, Deer Creek, Big Chico Creek, Butte Creek), 8-Feather River and Sutter Bypass (Feather River, Yuba River, and Bear River), 9-American River Basin (American River), 11-Eastside Delta Tributaries (Cosumnes River, Mokelumne River), 12-San Joaquin River (Friant Dam to Vernalis), 13-East San Joaquin (Stanislaus River, Tuolumne River, Merced River) (Fig. 3).

C2b. Approach: Sampling sites will be located in each stream to capture longitudinal gradients in stream conditions and stream macroinvertebrate communities (Fig. 2). Ten sites each will be located on the mainstem Sacramento River and San Joaquin River. Six sites each will be located on each of the sixteen tributary streams identified in section C2a. There are a total of 116 proposed sites. On streams with reservoirs, one site will be located just upstream (minimum 500 m) of the maximum extent of inundation to help establish the effect of the reservoir on the River Continuum Concept (Vannote et al. 1980). When possible, sites sampled in previous studies will be selected (e.g. Brown 2000, Brown and May, in press). All sites will be established as official USGS sampling sites and assigned a unique numerical code.

The 116 sites will be divided among 3 sampling teams of 3 persons each. At each site, stream macroinvertebrates will be collected using standard protocols. When present, riffles will be sampled using The California State Bioassessment Procedure (CSBP, Harrington 1999). At sites without riffles, large woody debris (snags) will be sampled as described in Cuffney et al. (1993) and Brown and May (in press), except that 3 replicate samples will be collected at each site as required by the CSBP. All sampling nets will have 500 micron mesh. Samples are preserved in 10 percent formalin. Macroinvertebrates will be collected during baseflow conditions in August and September of each of three-consequtive years. At sites where both habitat types exist, both will be sampled up to a maximum of 24 sites (20% of the total number of sites).

Habitat measurements will be taken at each site (Fitzpatrick 1998). Midstream dip samples will be analyzed for dissolved nutrients and major ions at the U.S. Geological Survey (USGS), National Water Quality Laboratory (NWQL). Basic field parameters will be measured at each site including, water temperature, specific conductance, pH, and dissolved oxygen. All the streams are gauged at one or more locations and instantaneous discharges will be measured at all wadeable sites. Instantaneous discharges at some large river sites will be estimated based on daily discharges measured at the nearest established stream gauge. Continuous temperature monitors will be installed at one or more sites on each stream, if temperature is not already being recorded as part of other studies.

Macroinvertebrate samples will be processed at the NWQL. Processing is based on a 300-organism fixed count. Organisms will be classified to the lowest practical taxon, usually genus for well-known groups such as mayflies (Ephemeroptera), caddisflies (Trichoptera), and stoneflies (Plecoptera), but some higher taxonomic group for some of the lesser known or difficult to identify taxa, such as water mites (Acari) or midges (Chironomidae). A USGS Open-file Report documenting all standard operating and quality assurance procedures is awaiting final approval and should be available by summer 2000. Data on macroinvertebrate abundances are entered into an EXCEL data form. The electronic data forms can then be compiled into a database. The data will then be used for a variety of statistical analyses.

Statistical analyses will include hierarchical clustering, simple correlation, indirect gradient analysis and direct gradient analysis. Hierarchical clustering will be utilized to group

sites on the basis of similarities in macroinvertebrate communities or environmental conditions. Analysis of variance will be utilized to verify that the clusters (groups) actually differ. Indirect gradient analysis includes ordination of the biotic community using techniques such as correspondence analysis or detrended correspondence analysis and then relating the gradients in the biotic communities to gradients in physical conditions using simple correlations with single environmental variables or composite environmental variables derived using techniques such as principal components analysis. Direct gradient analysis is similar but utilizes more complex statistical techniques, such as canonical correspondence analysis (ter Braak 1986), to select a group of independent environmental variables that best explain the variation in the macroinvertebrate community. The utility of various metrics will be assessed using similar techniques but substituting metric scores for macroinvertebrate abundance data. These or similar techniques have been successfully used in previous analyses of Central Valley streams (Brown 200, Brown and May, in press, Leland and Fend 1998, Brown et al. 1999).

The identification of metrics responsive to environmental gradients and perturbations using the above techniques is the first step in constructing an index for identifying sites that are in excellent condition or are degraded. We do not propose to develop an index with explicit scoring criteria because subjective judgments about definitions of excellent and degraded conditions are required. For example, is the baseline for an excellent ranking a pristine undammed stream or the best that can be expected with a dam in place? Decisions regarding the designation of such a baseline should likely be pursued through a process including stakeholder involvement.

Analysis of the three replicates collected at each site in the above analyses will indicate the sensitivity of the protocols to within-site variability. Analysis of three years of collections will provide some measure of the annual environmental and biotic variability that can be expected at a site. Comparisons between riffle and snag samples collected at the same sites will determine if direct comparisons are appropriate, or if calibration is necessary or possible. The alpha level for all statistical procedures will be 0.05 or lower.

During one of the three years, a subset of sites will be sampled in conjunction with the USGS, National Water Quality Assessment (NAWQA) study of the San Joaquin River Basin. NAWQA will collect the same habitat data (Fitzpatrick et al. 1998) plus fish relative abundance (Meador et al. 1993), quantitative and qualitative macroinvertebrate samples (Cuffney et al. 1993), and qualitative and quantitative algae samples (Porter et al. 1993). Comparisons of results with NAWQA results will determine how well our protocols reflect environmental conditions in comparison to other methods for collecting macroinvertebrates or other taxa (fish and algae).

Compilation and analysis of unpublished data from other programs will provide additional information addressing all three hypotheses. Within the study area we are presently aware of two data sets available for analyses. The California Department of Fish and Game has two years of fish and benthic macroinvertebrate data from the Cosumnes River drainage. The Sacramento River Watershed Program has sponsored collection of macroinvertebrate and some algae data from a number of sites in the Sacramento River drainage. Other data sets may also be available.

C2c. Monitoring and Assessment Plans: This section does not apply to this proposal but similar information is provided in the previous section.

C2d. Data Handling and Storage: As described in section C2b, all macroinvertebrate abundance data are entered into EXCEL spreadsheets that can be compiled into a database in the Sacramento office. The NWQL will also maintain copies of the original data in their database. Habitat data will be entered into EXCEL spreadsheets by USGS. The NWQL will automatically enter nutrient and major ion data into the USGS water quality database. These data will be downloaded and incorporated into EXCEL spreadsheets. All databases will include the unique USGS station identifier to ensure accurate cross-referencing between databases or compilation of data into a single database. All data will be available from USGS in Sacramento upon request.

C2e. Expected Products/Outcomes: Two important outcomes are expected from this project. First, by testing relationships between invertebrates and environmental conditions and determining a series of metrics summarizing these relationships, the project establishes the groundwork for a standardized bioassessment procedure for Central Valley streams supporting anadromous salmonids. The detailed habitat and water quality data collected as part of this project will no longer be required (although a simplified set of such measures will remain). Ecological conditions will be inferred directly from the macroinvertebrate data with more detailed follow-up studies limited to perceived problem areas. Conversely, if no such relationships can be established, then the utility of monitoring stream macroinvertebrates as a measure of ecological conditions will be brought into question and monitoring efforts and funds diverted into other areas.

Second, because of the extensive geographic coverage and multi-year design of this study, a useful database will be established for comparisons of ecological conditions among and within streams. Although the range of conditions represented in the database will depend on the annual variation within the three years of sampling, at present there is no such database for any of the ecological communities supported by Central Valley streams with anadromous fish populations.

We anticipate a minimum of one oral presentation per year at a national meeting such as the Annual Meeting of the North American Benthological Society or a local meeting such as the CALFED Science Conference. Annual reports documenting progress to date and data results will be submitted. Results from the first year will consist of analyses of existing data sets. In subsequent years, new data will be available. Preliminary results and interpretation will be presented as one or more seminars. A final interpretive report will also be prepared. We anticipate that some results will be published in peer-reviewed journals or as USGS reports throughout the duration of the project.

C2f. Work Schedule: The work schedule is presented in Table 1. CALFED funding is proposed to begin in federal fiscal year (FY) 2002. Site selection will occur in FY2001, at USGS expense. It was impractical to identify sites and obtain permission for access before the submission of this proposal because the number of sites proposed (116) precluded spending significant time and funds without some expectation of project funding. Failure to obtain access permission for all the proposed sites before FY 2002 would be grounds for CALFED to reduce funding to match the number of sites to be sampled or cancellation of the project.

Task 1, compilation and analysis of existing data, is not essential to completion of the other tasks; however, these analyses will be of considerable interest. California Department of Fish and Game has two years of data for fish and macroinvertebrate communities in the

Table 1. Proposed work schedule.

TASK	Oct-Dec 01	Jan-Mar 02	Apr-Jun 02	Jul-Sep 02	Oct-Dec 02	Jan-Mar 03	Apr-Jun 03	Jul-Sep 03	Oct-Dec 03	Jan-Mar 04	Apr-Jun 04	Jul-Sep 04	Oct-Dec 04	Jan-Mar 05	Apr-Jun 05	Jul-Sep 05	Oct-Dec 05	Jan-Mar 06	Apr-Jun 06
1 Compile and analyze existing data	X	X	X	X															
2 Field sampling			X	X			X	X			X	X							
3 Macroinvertebrate sample analysis				X	X	X		X	X	X		X	X	X	X				
4 Macroinvertebrate data input				X	X	X		X	X	X		X	X	X	X				
5 Environmental data input					X	X			X	X			X	X					
6 Data analysis							X	X			X	X			X	X	X		
7 Quarterly report	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
8 Annual report and presentation				X				X				X							
9 Final report and presentation																		X	X
10 Project administration	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Cosumnes River system. The Sacramento River Watershed Program has funded macroinvertebrate and some algae sampling efforts by California Department of Fish and Game, USGS, and California Department of Water Resources but the data has not been analyzed in any detail. Other data sets may also exist that we are not aware of at this time.

The remaining tasks are all inseparable from one another. There is a considerable time lag between collection of samples and environmental data and products because of processing time for macroinvertebrate samples and data entry time for habitat data (Table 1). Completion of satisfactory annual reports would serve as appropriate milestones for continued funding. Partial funding would require fewer years of sampling, reduction of sites, or reductions of replicate sampling at some or all sites. Sampling could be limited to one or two years. Sampling effort could be limited to specific sub-areas of the proposed study area (Fig. 3). For example, effort could be focused on the Sacramento River drainage, the San Joaquin River drainage, or on CALFED priority streams. One cost effective option would be to focus on the San Joaquin River drainage in coordination with the USGS NAWQA study. We could also collect only one or two samples at each site rather than three; however, this might limit the scientific defensibility of collecting only one sample as part of a cost-effective monitoring program. We are certainly willing to consider alternative designs that better fit CALFED needs at reduced cost.

C2g. Feasibility: The major personnel for this project have been responsible for projects of similar scope. Citations for methods were already provided in the Approach section (C2b). All of the methods proposed have already been used in other studies of California streams. Sampling is scheduled for summer months to minimize effects of variations in weather and flow regime. No special permits are required for this project other than a California Scientific Collecting Permit. Access issues were addressed in section C2f.

D. Applicability to CALFED ERP Goals and Implementation Plan and CVPIA Priorities

D1. ERP Goals and CVPIA priorities: Because stream macroinvertebrates are an important part of the stream food web in addition to being good indicators of environmental conditions, this

project addresses several of the CALFED goals and Central Valley Project Improvement Act (CVPIA) priorities.

Goal 1- At-Risk Species: The purpose of this proposal is to provide a tool to assess, using resident organisms, the effects of flow manipulation and other restoration actions on the ecological condition of streams supporting or potentially supporting various species of at-risk anadromous fish species (salmon and steelhead). Macroinvertebrates better reflect year-round stream conditions because their entire life cycle is dependent on the stream environment. This more accurate assessment of stream condition will help identify the importance of stream conditions in limiting anadromous species and also help identify situations where actions beneficial to one species, such as chinook salmon, may have detrimental effects on summer resident species such as steelhead or resident native stream fishes. Macroinvertebrates also serve as a food source for all species of fish, including at-risk anadromous fishes, so maintaining healthy populations of macroinvertebrates has a direct benefit as well as serving as environmental indicators.

Goal 2-Ecosystem Processes and Biotic Communities: As already explained, macroinvertebrates are responsive to environmental conditions and can serve as important indicators of ecosystem function. They are also directly important as part of the trophic structure of stream ecosystems.

Goal 4-Habitat types: Because macroinvertebrate communities reflect environmental conditions and ecological function they may be useful as indicators of the presence or condition of various stream types. As a simple example, different benthic macroinvertebrate communities are expected in coldwater and warmwater streams.

The project relates directly to the biological principles of CVPIA. Benthic macroinvertebrates are both an important part of the aquatic ecosystems supporting anadromous fish and a general indicator of the general condition of those ecosystems.

E. Qualifications:

Larry R. Brown (B.S., 1978, University of California-Irvine; M.S. and Ph.D., 1982 and 1988, University of California-Davis) is a Biologist with the U.S. Geological Survey, Water Resources Division. Dr. Brown has 20 years experience working in California aquatic systems, primarily streams and rivers. He is a recognized expert on the ecology of California stream fishes and, since starting work with the USGS, has gained considerable experience with benthic macroinvertebrates and algae. Dr. Brown is presently responsible for the ecological studies associated with three NAWQA study units in California. Dr. Brown has also been involved in several CALFED activities in recent years including membership on the Comprehensive Monitoring, Assessment, and Research Program (CMARP) Steering Committee, Chair of the CMARP Resident Fishes work group, preparation of the Ecosystem Restoration Program section of the CMARP report (CMARP 1999), author/editor of the Tidal Wetlands Whitepaper (in prep.), and Program Co-Chair of the 2000 CALFED Science Conference. Recent relevant publications include:

Brown, L.R. and J.T. May. Macroinvertebrate assemblages on woody debris and their relations with environmental variables in the lower Sacramento and San Joaquin river drainages, California. Environmental Monitoring and Assessment. In press.

Brown, L.R. 2000. Fish communities and their associations with environmental variables, lower San Joaquin River drainage, California. Environmental Biology of Fishes 57:251-269.

Brown, L.R., C.R. Kratzer, and N.M. Dubrovsky. 1999. Integrating chemical, water quality, habitat, and fish assemblage data from the San Joaquin River drainage, California. Pp. 25-62, in, C. Smith and K. Scow (eds.), Integrated assessment of ecosystem health, CRC Press, Boca Raton, FL.

Jason T. May (B.S., 1997, University of California-Davis) is a biologist with the U.S. Geological Survey, Water Resources Division, where he works through a contract managed by the California State University Foundation-Sacramento. Mr. May has worked for the USGS for the last four years where he has gained considerable experience in aquatic ecology. His major responsibilities have been for the planning and conduct of field work associated with the three USGS NAWQA studies in California, especially the recently completed NAWQA in the Sacramento River Basin, and for several studies of mercury contamination in the Sacramento River drainage. Mr. May served on the resident fishes and macroinvertebrate CMARP work teams. Mr. May has extensive experience using the analytical/statistical techniques to be used in this study. Mr. May has authored or co-authored several articles and reports:

Brown, L.R. and J.T. May. Macroinvertebrate assemblages on woody debris and their relations with environmental variables in the lower Sacramento and San Joaquin river drainages, California. Environmental Monitoring and Assessment. In press.

May, J.T. and L.R. Brown. Fish community structure in relation to environmental variation within the Sacramento River Basin and implications for the greater Central Valley. U.S. Geological Survey Open-file Report. This report is awaiting Regional approval and will also be submitted to a scientific journal for publication.

Brown, L.R. and T.J. May. Benthic macroinvertebrate assemblages and their relations with environmental variables in the Sacramento and San Joaquin river drainages, California, 1993-1997. Water-Resources Investigations Report. This report is awaiting Regional approval.

F. Cost

F1. Budget: The detailed annual budget (Table 2) and summary budget (Table 3) appear at the end of the proposal. The table footnotes provide general descriptions for each cost category and breakdowns of salary and overhead rates. As explained in section C2f, the extended time frame of the budget is required because of time lags involved in having the macroinvertebrate samples processed, habitat data entry completed, and the timing of sampling activities at the end of the fiscal year. The total funding request is for $2,860,496 over five years, with most funds expended for sampling and processing activities in the first three years.

F2. Cost-Sharing: No firm commitments for cost-sharing have been identified for this project, except for support of site identification and obtaining permission to access sites. However, the

work schedule for this project coincides with the work schedule for the NAWQA study of the San Joaquin-Tulare Basin study area, which includes the San Joaquin River drainage. Based on past funding levels for NAWQA studies we anticipate on the order of $850,000 will be spent on ecological studies over the approximately 5 years of intensive activity in the basin, including salary, laboratory, and report preparation costs. Larry Brown will be responsible for the design of the ecological studies and he and Jason May will be responsible for the training and supervision of field crews to do the work. We anticipate significant co-location of sites in the San Joaquin River drainage and there may be some savings in field costs if sampling activities can be coordinated. At a minimum, the NAWQA project will provide data on other biological communities (algae and fish) and other methods for collecting stream macroinvertebrates for some of the same streams (probably San Joaquin, Stanislaus, Tuolumne, and Merced rivers) proposed for this study. Analyses of these data will help determine the relative effectiveness of monitoring macroinvertebrates in comparison to monitoring of algae or resident fishes and the comparability of NAWQA macroinvertebrate sampling methods with the methods proposed in this study. The latter would be particularly important in determining whether data collected during previous (and future) NAWQA studies in the Sacramento and San Joaquin river drainages could be integrated into a CALFED database of macroinvertebrate data.

G. Local Involvement: Because the project mainly involves field sampling rather than construction or land purchase, it does not directly affect members of the public. We will maintain contact with private landowners to maintain access to sites. We also anticipate maintaining contact with organized watershed groups, such as the Sacramento River Watershed Program and the Deer Creek Conservancy, interagency groups, such as the Interagency Ecological Program (IEP), and other organized groups interested in our activities. Our main method of communication will be presentations at scientific, watershed, and other group meetings.

H. Compliance with Standard Terms and Conditions: The applicant will comply with the Standard Terms and Conditions.

I. Literature cited:

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid bioassessment protocols for use in streams and wadeable rivers: periphyton, benthic macroinvertebrates, and fish, second edition. EPA 841-B-99-002. U.S. Environmental Protection Agency, Office of Water, Washington, D.C.

Brown, L.R. 2000. Fish communities and their associations with environmental variables, lower San Joaquin River drainage, California. Environmental Biology of Fishes 57:251-269.

Brown, L.R. 1997. Aquatic biology of the San Joaquin-Tulare basins: analysis of available data through 1992. U.S. Geological Survey Water-Supply Paper 2471. 89 pp.

Brown, L.R. and J.T. May. Macroinvertebrate assemblages on woody debris and their relations with environmental variables in the lower Sacramento and San Joaquin river drainages, California. Environmental Monitoring and Assessment. In press.

Brown, L.R. and P.B. Moyle. 1993. Distribution, ecology, and status of the fishes of the San Joaquin River drainage, California. California Fish and Game 79:96-114.

CALFED. 2000. Ecosystem restoration project and programs, 2001 proposal solicitation package. CALFED Bay-Delta Program, Sacramento, California.

CMARP. 1999. Recommendations for the implementation and continued refinement of a comprehensive monitoring, assessment, and research program. CALFED Bay-Delta Program, Sacramento, California.

Cuffney, T.F., M.E. Gurtz, and M.R. Meador. 1993. Methods for collecting benthic invertebrate samples as part of the National Water-Quality Assessment Program. U.S. Geological Survey, Open-File Report 93-406, Raleigh, North Carolina, 66 pp.

Fausch, K.D., J.R. Karr, P.R. Yant. 1984. Regional application of an index of biotic integrity based on stream fish communities. Transactions of the American Fisheries Society 113:39-55.

Fitzpatrick, F.A., I.R. Waite, P.J. D'Arconte, M.R. Meador, M.A. Maupin, and M.E. Gurtz. 1998. Revised methods for characterizing stream habitat in the National Water-Quality Assessment Program. U.S. Geological Survey, Water-Resources Investigations Report 98-4052. 67 pp.

Harrington, J.M. 1996. California state bioassessment procedure. California Department of Fish and Game, Water Pollution Control Laboratory, Rancho Cordova, California.

Hill, B.H., A.T. Herlihy, P.R. Kaufmann, R.J. Stevenson, F.H. McCormick, and B. Johnson. 2000. Use of periphyton assemblage data as an index of biotic integrity. Journal of the North American Benthological Society 19:50-67.

Hughes, R.M. and J.R. Gammon. 1987. Longitudinal changes in fish assemblages and water quality in the Willamette River, Oregon. Transactions of the American Fisheries Society 116:196-209.

Hughes, R.M., P.R. Kaufmann, A.T. Herlihy, T.M. Kincaid, L. Reynolds, and D.P. Larsen. 1998. A process for developing and evaluating indices of fish assemblage integrity. Canadian Journal of Fisheries and Aquatic Sciences 55:1618-1631.

Karr, J.R. 1981. Assessment of biotic integrity using fish communities. Fisheries 6:21-27.

Karr, J.R. and E.W. Chu. 1998. Restoring life in running waters: better biological monitoring. Island Press. 200 pp.

Leland, H.V. and S.V. Fend. 1998. Benthic invertebrate distributions in the San Joaquin River, California, in relation to physical and chemical factors. Canadian Journal of Fisheries and Aquatic Sciences 55:1051-1067.

Marchetti, M.P. and P.B. Moyle. In press. Keeping alien fishes at bay: effects of flow regime and habitat structure on fish assemblages in a regulated California stream. Ecological Applications.
Ward, J.V. and J.A. Stanford. 1983. The serial discontinuity concept of lotic ecosystems. Pages 29-42, *in*, T.D. Fontaine and S.M. Bartells (eds.), Dynamics of Lotic Ecosystems. Ann Arbor Science, Ann Arbor.

Meador, M.R., T.F. Cuffney, and M.E. Gurtz. 1993. Methods for sampling fish communities as part of the National Water-Quality Assessment Program. U.S. Geological Survey, Open-File Report 93-104, Raleigh, North Carolina, 40 pp.

Porter, S.G., T.F. Cuffney, M.E. Gurtz, and M.R. Meador. 1993. Methods for collecting algal samples as part of the National Water-Quality Assessment Program. U.S. Geological Survey, Open-File Report 93-409, Raleigh, North Carolina, 39 pp.

Stevenson, R.J. and Y. Pan. Assessing ecological conditions in rivers and streams with diatoms. Pages 11-40, *in*, E.F. Stormer and J.P Smol (eds.), The diatoms: applications to the environmental and earth sciences. Cambridge University Press, Cambridge, UK.

ter Braak, C.J.F. 1986. Canonical correspondence analysis: a new eigenvector technique for multivariate direct gradient analysis. Ecology 67:1167-1179.
Vannote, R.L., G.W. Minshall, K.W. Cummins, J.R. Sedell, and C.E. Cushing. 1980. The river continuum concept. Canadian Journal of Fisheries and Aquatic Sciences 37:130-137.

Ward, J.V. and J.A. Stanford. 1995. The serial discontinuity concept: extending the model to floodplain rivers. Regulated Rivers: Research and Management 10:159-168.

Table 2. Annual budget by year and cost category.

Year	Task	Personnel	Direct Labor (Days)	Direct Salary and Benefits	Travel	Service Contracts[1]	Supplies & Expend-ables	Miscellaneous Direct Costs (Publication costs, vehicle rental etc.)[2]	Overhead on non-analytical costs (43% of total cost)[3]	Overhead on analytical costs (21% of total cost)[4]	Total Cost
Year 1	**Task 1: Compile, analyze, and report on existing data sets**										
		Larry Brown	30	$12,179					$9,075		$21,254
		Jason May	90	$14,801					$11,016		$25,817
		Database manager	20	$5,014					$3,732		$8,746
								$42,594	$31,702		$74,296
	Task 2: Field activities and sample processing										
		Larry Brown	15	$6,089					$4,532		$10,621
		Jason May	45	$7,400					$5,508		$12,908
		Field crew (9)	705	$81,075					$60,073		$141,418
					$51,450		$27,000	$3,600	$61,069		$143,119
	Equipment (3 peristalic pumps)						$3,000		$2,233		$5,233
	Nutrient and major ion analyses					$31,892				$8,642	$40,534
	Processing macroinvertebrate samples					$235,200				$63,732	$298,932
	Project management (includes outreach)										
		Larry Brown	30	$12,179					$9,065		$21,244
					$1,050				$782		$1,832
	Contingency[5]							$26,726	$19,892		$46,618
Total Cost Year 1				$138,737	$52,500	$267,092	$30,000	$72,920	$218,679	$72,374	$852,572
Year 2	**Task 1: Field activities and sample processing**										
		Larry Brown	15	$6,400					$4,763		$11,163
		Jason May	45	$7,814					$5,816		$13,630
		Field crew (9)	705	$85,129					$63,360		$148,489
					$53,900		$12,600	$3,780	$52,309		$122,589
	Nutrient and major ion analyses					$33,487				$9,074	$42,561
	Processing macroinvertebrate samples					$246,960				$66,919	$313,879
	Task 2: Data analysis and annual report										
		Larry Brown	30	$12,800					$9,527		$22,327

		Jason May	60	$13,590					$10,115		$23,705
		Database manager	20	$5,267					$3,920		$9,187
		Tech. (data input etc.)	135	$16,301					$12,133		$28,434
								$43,589	$32,443		$76,032
	Project management (includes outreach)										
		Larry Brown	30	$12,800					$9,527		$22,327
					$1,100				$819		$1,919
	Contingency							$27,397	$20,391		$47,788
Total Cost Year 2:				$160,101	$55,000	$280,447	$12,600	$74,766	$225,123	$75,993	$884,030
Year 3	**Task 1: Field activities and sample processing**										
		Larry Brown	15	$6,728					$5,008		$11,736
		Jason May	45	$8,228					$6,124		$14,352
		Field crew (9)	705	$89,993					$66,981		$156,974
					$56,350		$13,200	$3,969	$54,719		$128,238
	Nutrient and major ion analyses					$35,161				$9,528	$44,689
	Processing macroinvertebrate samples					$259,308				$70,265	$329,573
	Task 2: Data analysis and annual report										
		Larry Brown	30	$13,455					$10,014		$23,469
		Jason May	60	$10,971					$8,166		$19,137
		Database manager	20	$5,543					$4,126		$9,669
		Tech. (data input etc.)	135	$17,233					$12,826		$30,059
								$45,868	$34,139		$80,007
	Project management (includes outreach)										
		Larry Brown	30	$13,455					$10,014		$23,469
					$1,150				$856		$2,006
	Contingency							$28,801	$21,436		$50,237
Total Cost Year 3:				$165,606	$57,500	$294,469	$13,200	$78,638	$234,409	$79,793	$923,615
Year 4	**Task 1: Data analysis and final report**										
		Larry Brown	20	$9,430					$7,019		$16,449
		Jason May	40	$7,682					$5,718		$13,400
		Database manager	20	$5,819					$4,331		$10,150

		Tech. (data input etc.)	135	$18,164					$13,519		$31,683
								$4,515	$3,360		$7,875
	Project management (includes outreach)										
		Larry Brown	30	$13,455					$11,218		$24,673
					$1,200				$856		$2,093
	Contingency							$3,048	$2,269		$5,317
Total Cost Year 4:				$54,550	$1,200	$0	$0	$7,563	$48,290		$111,640
Year 5	**Task 1: Data analysis and final report**										
		Larry Brown	30	$14,870					$11,068		$25,938
		Jason May	60	$12,144					$9,039		$21,183
		Database manager	20	$6,118					$4,554		$10,672
								$7,200	$5,359		$12,559
	Project management (includes outreach)										
		Larry Brown	15	$7,435					$5,534		$12,969
					$630				$469		$1,099
	Contingency							$2,419	$1,800		$4,219
Total Cost Year 5:				$40,567	$630	$0	$0	$9,619	$37,823		$88,639
Total Cost All Years:				$559,561	$166,830	$842,008	$55,800	$243,506	$764,324	$228,160	$2,860,496

[1] Annual salaries are not listed but can be obtained by dividing Direct Salary and Benefits by the number of days shown and multiplying by 210 days. This value will also include a 15 percent assessment for leave and holiday benefits that should be deducted to obtained the actual salary of the position. All salaries are estimated based on a 5 percent inflation rate from the base salary expected in federal fiscal year 2002.

[2] Travel for field sampling is based on estimates of days that sampling crews will spend greater than about 50 miles from Sacramento. Costs are estimated from standard federal per diem rates for the cities and counties where crews are likely to stay. The travel associated with adminstrative duties is for local and out-of-state travel for presentation of results at national and local meetings and other meeting attendance as needed.

[3] All analytical work will be done at the U.S. Geological Survey (USGS) National Water Quality Laboratory.

[4] This item includes miscellaneous equipment required for habitat measurements and expendable items such as sample bottles and sample preservatives. These costs are highest in the first year because of purchase of items expected to last for the duration of the project.

[5] Miscellaneous direct costs include vehicle rental, editorial services (includes editor and illustrator time charged as a flat rate of 8% of net project cost), and publication costs (page charges and reprint costs associated with publication in scientifi

[6] USGS overhead is a combination of National (WOTSC) and District (DOTSC) costs. Simplistically, the WOTSC percentage is based on Headquarters and Regional Office expenditures divided by the entire anticipated USGS funding. The DOTSC percentage is based on each District's common services expenditures divided by the District's anticipated funding. These percentages are then applied separately to the net expenses of a proposal. WOTSC consists of labor and non-labor expenses for Headquarters and Regional Office staffs, along with general expenses such as (but not limited to) rent, communications, and database management. DOTSC consists of labor and non-labor expenses at the District level for Management and Services support staff (technical, administrative, computer, and database management), and general District expenses such as (but not limited to) rent, communications, and database management.

[7] Overhead for the National Water Quality Laboratory is calculated in a similar manner to WOTSC and DOTSC for costs of maintining the National Water Quality Laboratory.

[8] The contingency expense (5% of net costs) is meant to cover unexpected changes in costs or overhead rates.

Table 3. Summary budget by task, year and cost category.

Year	Task	Personnel	Direct Labor (Days)	Direct Salary and Benefits[1]	Travel[2]	Service Contracts[3]	Supplies & Expend-ables[4]	Miscellaneous Direct Costs (Publication costs, vehicle rental etc.)[5]	Overhead on non-analytical costs (43% of total cost)[6]	Overhead on analytical costs (21% of total cost)[7]	Total Cost
Year 1	**Task 1: Compile, analyze, and report on existing data sets**										
				$31,994	$0	$0	$0	$42,594	$55,525	$0	$130,113
	Task 2: Field activities and sample processing										
				$94,564	$51,450	$267,092	$30,000	$3,600	$133,415	$72,374	$652,765
	Project management (includes outreach)										
				$12,179	$1,050	$0	$0	$0	$9,847	$0	$23,076
	Contingency[8]							$26,726	$19,892		$46,618
Total Cost Year 1				$138,737	$52,500	$267,092	$30,000	$72,920	$218,679	$72,374	$852,572
Year 2	**Task 1: Field activities and sample processing**										
				$99,343	$53,900	$280,447	$12,600	$3,780	$126,248	$75,993	$652,311
	Task 2: Data analysis and annual report										
				$47,958	$0	$0	$0	$43,589	$68,138	$0	$159,685
	Project management (includes outreach)										
				$12,800	$1,100	$0	$0	$0	$10,346	$0	$24,246
	Contingency							$27,397	$20,391		$47,788
Total Cost Year 2:				$160,101	$55,000	$280,447	$12,600	$74,766	$225,123	$75,993	$884,030
Year 3	**Task 1: Field activities and sample processing**										
				$104,949	$56,350	$294,469	$13,200	$3,969	$132,832	$79,793	$685,562
	Task 2: Data analysis and annual report										
				$47,202	$0	$0	$0	$45,868	$69,271	$0	$162,341
	Project management (includes outreach)										
				$13,455	$1,150	$0	$0	$0	$10,870	$0	$25,475
	Contingency							$28,801	$21,436		$50,237
Total Cost Year 3:				$165,606	$57,500	$294,469	$13,200	$78,638	$234,409	$79,793	$923,615
Year 4	**Task 1: Data analysis and final report**										
				$41,095	$0	$0	$0	$4,515	$33,947	$0	$79,557
	Project management (includes outreach)										
				$13,455	$1,200	$0	$0	$0	$12,074	$0	$26,766

	Contingency						$3,048	$2,269		$5,317
Total Cost Year 4:			$54,550	$1,200	$0	$0	$7,563	$48,290		$111,640
Year 5	**Task 1: Data analysis and final report**									
			$33,132	$0	$0	$0	$7,200	$30,020	$0	$70,352
	Project management (includes outreach)									
			$7,435	$630	$0	$0	$0	$6,003	$0	$14,068
							$2,419	$1,800		$4,219
	Contingency						$9,619	$37,823		$88,639
Total Cost Year 5:			$40,567	$630	$0	$0	$243,506	$764,324	$228,160	$2,860,496
Total Cost All Years:			$559,561	$166,830	$842,008	$55,800				

[1] Annual salaries are not listed but can be obtained by dividing Direct Salary and Benefits by the number of days shown and multiplying by 210 days. This value will also include a 15 percent assessment for leave and holiday benefits that should be deducted to obtained the actual salary of the position. All salaries are estimated based on a 5 percent inflation rate from the base salary expected in federal fiscal year 2002.

[2] Travel for field sampling is based on estimates of days that sampling crews will spend greater than about 50 miles from Sacramento. Costs are estimated from standard federal per diem rates for the cities and counties where crews are likely to stay. The travel associated with adminstrative duties is for local and out-of-state travel for presentation of results at national and local meetings and other meeting attendance as needed.

[3] All analytical work will be done at the U.S. Geological Survey (USGS) National Water Quality Laboratory.

[4] This item includes miscellaneous equipment required for habitat measurements and expendable items such as sample bottles and sample preservatives. These costs are highest in the first year because of purchase of items expected to last for the duration of the project.

[5] Miscellaneous direct costs include vehicle rental, editorial services (includes editor and illustrator time charged as a flat rate of 8% of net project cost), and publication costs (page charges and reprint costs associated with publication in scientifi

[6] USGS overhead is a combination of National (WOTSC) and District (DOTSC) costs. Simplistically, the WOTSC percentage is based on Headquarters and Regional Office expenditures divided by the entire anticipated USGS funding. The DOTSC percentage is based on each District's common services expenditures divided by the District's anticipated funding. These percentages are then applied separately to the net expenses of a proposal. WOTSC consists of labor and non-labor expenses for Headquarters and Regional Office staffs, along with general expenses such as (but not limited to) rent, communications, and database management. DOTSC consists of labor and non-labor expenses at the District level for Management and Services support staff (technical, administrative, computer, and database management), and general District expenses such as (but not limited to) rent, communications, and database management.

[7] Overhead for the National Water Quality Laboratory is calculated in a similar manner to WOTSC and DOTSC for costs of maintining the National Water Quality Laboratory.

[8] The contingency expense (5% of net costs) is meant to cover unexpected changes in costs or overhead rates.

Figure 1. Conceptual model. Anadromous fishes are not the best choice to assess the ecological consequences of flow manipulations or other restoration actions because most individuals are present during only part of the year (see life cycle below). In contrast, stream macroinvertebrates complete their entire life cycle (represented by circles with arrowheads) in a limited reach of stream. Community structure varies among reaches in response to local and upstream environmental conditions.

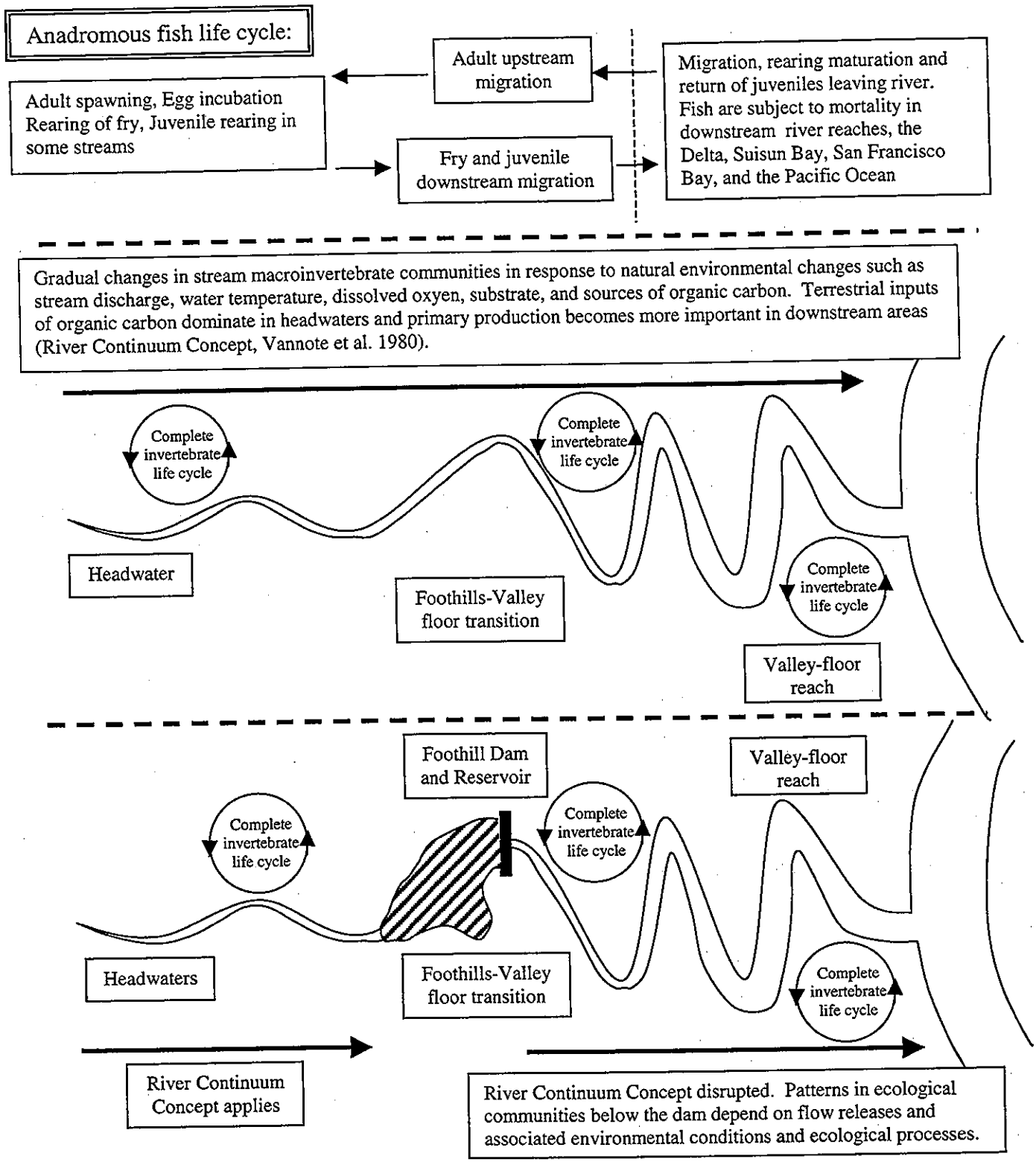
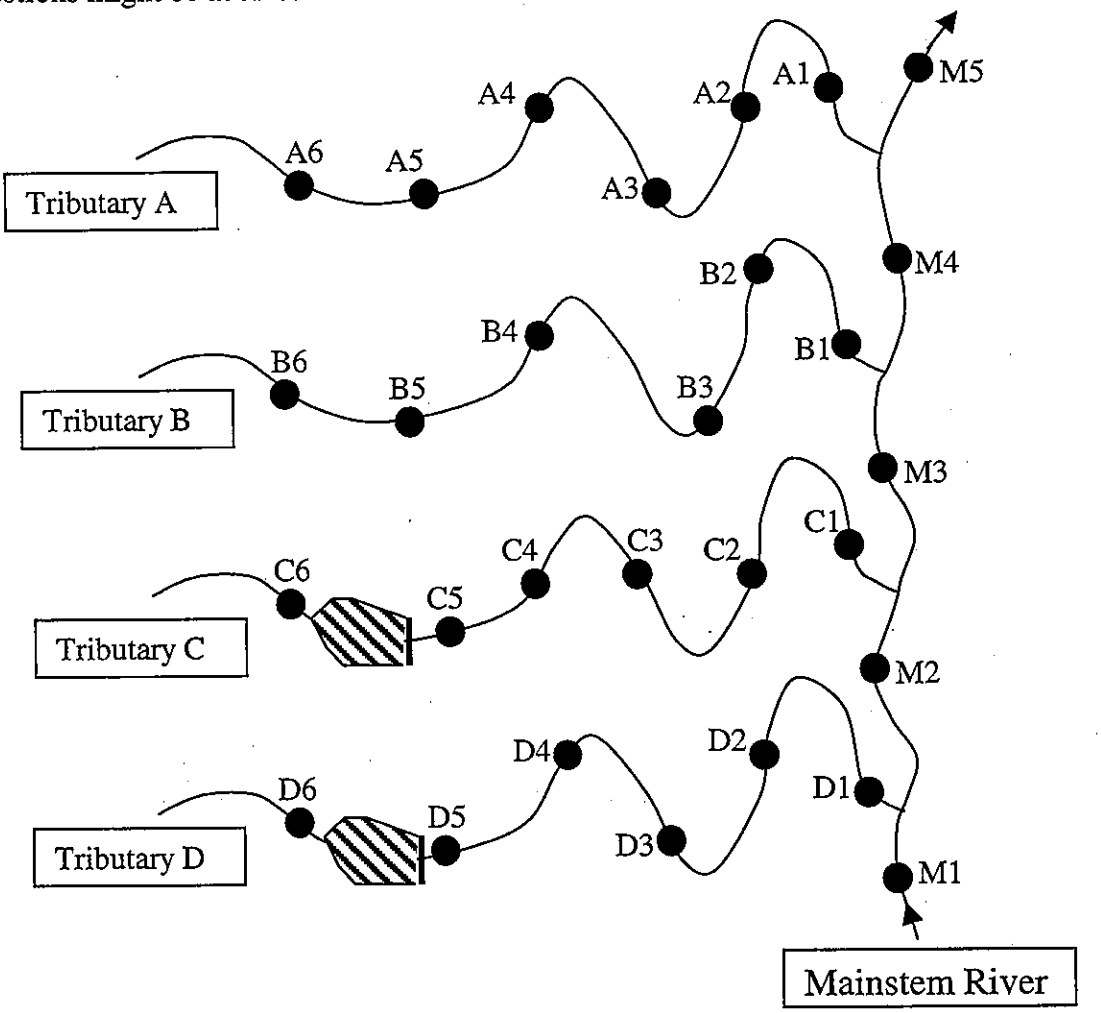


Figure 2. Conceptual representation of the proposed study design and how some specific questions might be addressed.



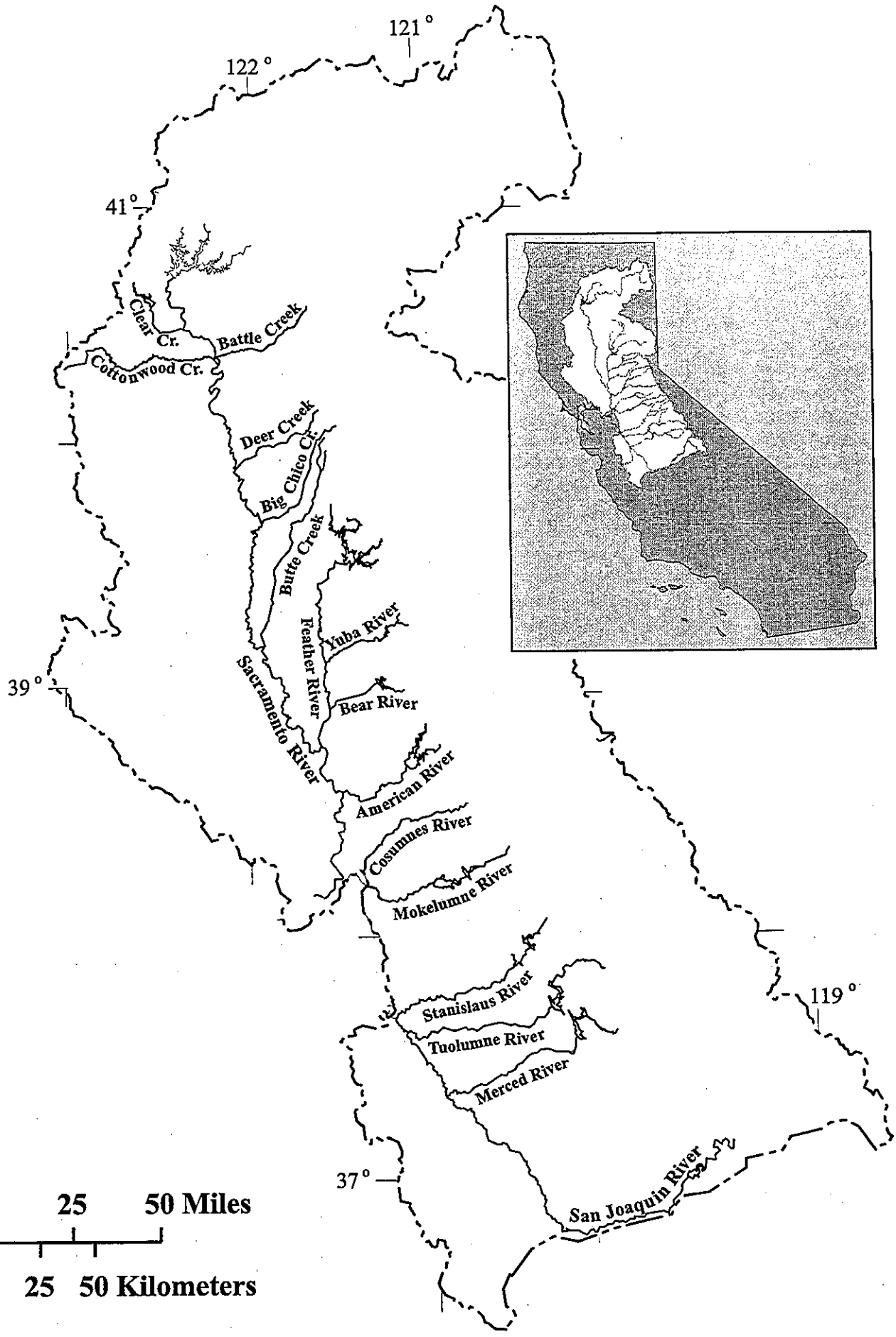
Question: What differences in benthic macroinvertebrate communities are there between dammed and free-flowing streams?

- Compare differences between A5-A6 and B5-B6 with differences between C5-C6 and D5-D6.
- Compare gradients in communities and environmental conditions from A1-A5 and B1-B5 with those from C1-C5 and D1-D5.

Question: Does an adaptive management experiment of several years duration on stream C result in changes in ecological conditions in the stream, as measured by macroinvertebrate communities?

- Compare gradients in macroinvertebrate communities and environmental conditions from C1 to C5 after implementation of the experiment with gradients observed in one or more years of pre-experiment data.
- Compare gradients in communities and environmental conditions from A1-A5, B1-B5, and D1-D5 over the same time assessed for C1-C5 to address the effects of natural annual variability.
- Assuming that the free-flowing stream A represents the target for stream restoration actions, determine if the gradients in macroinvertebrate communities and environmental conditions in stream C are more similar to those in stream A after the adaptive management experiment has been implemented.

Figure 3. Proposed sampling locations. Only the segments of streams to be sampled are shown.



Environmental Compliance Checklist

All applicants must fill out this Environmental Compliance Checklist. Applications must contain answers to the following questions to be responsive and to be considered for funding. *Failure to answer these questions and include them with the application will result in the application being considered nonresponsive and not considered for funding.*

1. **Do any of the actions included in the proposal require compliance with either the California Environmental Quality Act (CEQA), the National Environmental Policy Act (NEPA), or both?**

   ____ **YES** X **NO**

2. **If you answered yes to # 1, identify the lead governmental agency for CEQA/NEPA compliance.**

   _____
   Lead Agency

3. **If you answered no to # 1, explain why CEQA/NEPA compliance is not required for the actions in the proposal.**
   This project only involves field sampling of non-listed species.

4. **If CEQA/NEPA compliance is required, describe how the project will comply with either or both of these laws. Describe where the project is in the compliance process and the expected date of completion.**

5. **Will the applicant require access across public or private property that the applicant does not own to accomplish the activities in the proposal?**

   X **YES** ____ **NO**

   If yes, the applicant must attach written permission for access from the relevant property owner(s). Failure to include written permission for access may result in disqualification of the proposal during the review process. Research and monitoring field projects for which specific field locations have not been identified will be required to provide access needs and permission for access with 30 days of notification of approval.

   Specific field locations will be identified and permission obtained for access to private property after notification of approval.

6. **Please indicate what permits or other approvals may be required for the activities contained in your proposal. Check all boxes that apply.**

LOCAL		
Conditional use permit	___	
Variance	___	
Subdivision Map Act approval	___	
Grading permit	___	
General plan amendment	___	
Specific plan approval	___	
Rezone		___
Williamson Act Contract cancellation	___	
Other _____ (please specify)		
None required	X	
STATE		
CESA Compliance	___	**(CDFG)**
Streambed alteration permit	___	**(CDFG)**
CWA § 401 certification	___	**(RWQCB)**
Coastal development permit	___	**(Coastal Commission/BCDC)**
Reclamation Board approval	___	
Notification	___	**(DPC, BCDC)**
Other California Scientific Collecting Permit (please specify)		
None required	___	
FEDERAL		
ESA Consultation	___	**(USFWS)**
Rivers & Harbors Act permit	___	**(ACOE)**
CWA § 404 permit	___	**(ACOE)**
Other _____ (please specify)		
None required	X	

DPC = Delta Protection Commission
CWA = Clean Water Act
CESA = California Endangered Species Act
USFWS = U.S. Fish and Wildlife Service
ACOE = U.S. Army Corps of Engineers

ESA = Endangered Species Act
CDFG = California Department of Fish and Game
RWQCB = Regional Water Quality Control Board
BCDC= Bay Conservation and Development Comm.

Land Use Checklist

All applicants must fill out this Land Use Checklist for their proposal. Applications must contain answers to the following questions to be responsive and to be considered for funding. *Failure to answer these questions and include them with the application will result in the application being considered nonresponsive and not considered for funding.*

1. **Do the actions in the proposal involve physical changes to the land(i.e. grading, planting vegetation, or breeching levees) or restrictions in land use (i.e. conservation easement or placement of land in a wildlife refuge)?**

   _____ YES X NO

2. **If NO to # 1, explain what type of actions are involved in the proposal (i.e., research only, planning only).**
   research/ monitoring only

3. **If YES to # 1, what is the proposed land use change or restriction under the proposal?**

4. **If YES to # 1, is the land currently under a Williamson Act contract?**

   _____ YES _____ NO

5. **If YES to # 1, answer the following:**

   Current land use _____
   Current zoning _____
   Current general plan designation _____

6. **If YES to #1, is the land classified as Prime Farmland, Farmland of Statewide Importance or Unique Farmland on the Department of Conservation Important Farmland Maps?**

   _____ YES _____ NO _____ DON'T KNOW

7. **If YES to # 1, how many acres of land will be subject to physical change or land use restrictions under the proposal?**
   _____

8. **If YES to # 1, is the property currently being commercially farmed or grazed?**

   _____ YES _____ NO

9. **If YES to #8, what are** **the number of employees/acre**_____
   the total number of employees _____

10. Will the applicant acquire any interest in land under the proposal (fee title or a conservation easement)?

_____ YES X NO

11. What entity/organization will hold the interest?_____

12. If YES to # 10, answer the following:

Total number of acres to be acquired under proposal _____
Number of acres to be acquired in fee _____
Number of acres to be subject to conservation easement _____

13. For all proposals involving physical changes to the land or restriction in land use, describe what entity or organization will:

manage the property _____

provide operations and maintenance services _____

conduct monitoring _____

14. For land acquisitions (fee title or easements), will existing water rights also be acquired?

_____ YES _____ NO

15. Does the applicant propose any modifications to the water right or change in the delivery of the water?

_____ YES _____ NO

16. If YES to # 15, describe_____

United States Department of the Interior

U.S. GEOLOGICAL SURVEY

Placer Hall, 6000 J Street
Sacramento, California
(916) 278-3098
FAX: (916) 278-3071
lrbrown@usgs.gov

Amador County
County Courthouse
108 Court Street
Jackson, CA 95642-2308

15 May 2000

Dear Ms. or Sir:

This letter is to inform your county that I have submitted a proposal to the CALFED Program in response to the Ecosystem Restoration Program, 2001 Project Solicitation Package. The proposal is titled, "Using Benthic Macroinvertebrate Communities for Assessment of Adaptive Management Actions in Streams Supporting Anadromous Salmonids." This proposal is for research/monitoring only and, if funded, may include one or more sampling sites on streams or rivers in your county. If the proposal is selected for funding, I will notify you by a second letter, which will include a copy of the proposal. After that I will be selecting sampling sites for the study. If any sampling sites occur in your county I will contact the appropriate public agencies or private landowners to obtain permission to access the site before any sampling takes place. Please feel free to contact me if you would like any additional information at this time.

Sincerely,

Larry R. Brown

Larry R. Brown
U.S. Geological Survey
Placer Hall
6000 J Street
Sacramento, CA 95819-6129

Phone: 916-278-3098
FAX: 916-278-3071
e-mail: lrbrown@usgs.gov

United States Department of the Interior

U.S. GEOLOGICAL SURVEY

Placer Hall, 6000 J Street
Sacramento, California
(916) 278-3098
FAX: (916) 278-3071
lrbrown@usgs.gov

Butte County
196 Memorial Way
P.O. Box 3700
Chico, CA 95926

15 May 2000

Dear Ms. or Sir:

This letter is to inform your county that I have submitted a proposal to the CALFED Program in response to the Ecosystem Restoration Program, 2001 Project Solicitation Package. The proposal is titled, "Using Benthic Macroinvertebrate Communities for Assessment of Adaptive Management Actions in Streams Supporting Anadromous Salmonids." This proposal is for research/monitoring only and, if funded, may include one or more sampling sites on streams or rivers in your county. If the proposal is selected for funding, I will notify you by a second letter, which will include a copy of the proposal. After that I will be selecting sampling sites for the study. If any sampling sites occur in your county I will contact the appropriate public agencies or private landowners to obtain permission to access the site before any sampling takes place. Please feel free to contact me if you would like any additional information at this time.

Sincerely,

Larry R. Brown

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U.S. Geological Survey
Placer Hall
6000 J Street
Sacramento, CA 95819-6129

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FAX: 916-278-3071
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United States Department of the Interior

U.S. GEOLOGICAL SURVEY

Placer Hall, 6000 J Street
Sacramento, California
(916) 278-3098
FAX: (916) 278-3071
lrbrown@usgs.gov

Calaveras County
891 Mountain Ranch Road
San Andreas, CA 95249

15 May 2000

Dear Ms. or Sir:

This letter is to inform your county that I have submitted a proposal to the CALFED Program in response to the Ecosystem Restoration Program, 2001 Project Solicitation Package. The proposal is titled, "Using Benthic Macroinvertebrate Communities for Assessment of Adaptive Management Actions in Streams Supporting Anadromous Salmonids." This proposal is for research/monitoring only and, if funded, may include one or more sampling sites on streams or rivers in your county. If the proposal is selected for funding, I will notify you by a second letter, which will include a copy of the proposal. After that I will be selecting sampling sites for the study. If any sampling sites occur in your county I will contact the appropriate public agencies or private landowners to obtain permission to access the site before any sampling takes place. Please feel free to contact me if you would like any additional information at this time.

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United States Department of the Interior

U.S. GEOLOGICAL SURVEY

Placer Hall, 6000 J Street
Sacramento, California
(916) 278-3098
FAX: (916) 278-3071
lrbrown@usgs.gov

Colusa County
County Courthouse
546 Jay Street
Colusa, CA 95932-2443

15 May 2000

Dear Ms. or Sir:

This letter is to inform your county that I have submitted a proposal to the CALFED Program in response to the Ecosystem Restoration Program, 2001 Project Solicitation Package. The proposal is titled, "Using Benthic Macroinvertebrate Communities for Assessment of Adaptive Management Actions in Streams Supporting Anadromous Salmonids." This proposal is for research/monitoring only and, if funded, may include one or more sampling sites on streams or rivers in your county. If the proposal is selected for funding, I will notify you by a second letter, which will include a copy of the proposal. After that I will be selecting sampling sites for the study. If any sampling sites occur in your county I will contact the appropriate public agencies or private landowners to obtain permission to access the site before any sampling takes place. Please feel free to contact me if you would like any additional information at this time.

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U.S. Geological Survey
Placer Hall
6000 J Street
Sacramento, CA 95819-6129

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United States Department of the Interior

U.S. GEOLOGICAL SURVEY

Placer Hall, 6000 J Street
Sacramento, California
(916) 278-3098
FAX: (916) 278-3071
lrbrown@usgs.gov

El Dorado County
330 Fair Lane
Placerville, CA 95667

15 May 2000

Dear Ms. or Sir:

This letter is to inform your county that I have submitted a proposal to the CALFED Program in response to the Ecosystem Restoration Program, 2001 Project Solicitation Package. The proposal is titled, "Using Benthic Macroinvertebrate Communities for Assessment of Adaptive Management Actions in Streams Supporting Anadromous Salmonids." This proposal is for research/monitoring only and, if funded, may include one or more sampling sites on streams or rivers in your county. If the proposal is selected for funding, I will notify you by a second letter, which will include a copy of the proposal. After that I will be selecting sampling sites for the study. If any sampling sites occur in your county I will contact the appropriate public agencies or private landowners to obtain permission to access the site before any sampling takes place. Please feel free to contact me if you would like any additional information at this time.

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Placer Hall
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Sacramento, CA 95819-6129

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United States Department of the Interior

U.S. GEOLOGICAL SURVEY

Placer Hall, 6000 J Street
Sacramento, California
(916) 278-3098
FAX: (916) 278-3071
lrbrown@usgs.gov

Fresno County
2281 Tulare St., Room 301
Fresno, CA 93721

15 May 2000

Dear Ms. or Sir:

This letter is to inform your county that I have submitted a proposal to the CALFED Program in response to the Ecosystem Restoration Program, 2001 Project Solicitation Package. The proposal is titled, "Using Benthic Macroinvertebrate Communities for Assessment of Adaptive Management Actions in Streams Supporting Anadromous Salmonids." This proposal is for research/monitoring only and, if funded, may include one or more sampling sites on streams or rivers in your county. If the proposal is selected for funding, I will notify you by a second letter, which will include a copy of the proposal. After that I will be selecting sampling sites for the study. If any sampling sites occur in your county I will contact the appropriate public agencies or private landowners to obtain permission to access the site before any sampling takes place. Please feel free to contact me if you would like any additional information at this time.

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Sacramento, CA 95819-6129

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United States Department of the Interior

U.S. GEOLOGICAL SURVEY

Placer Hall, 6000 J Street
Sacramento, California
(916) 278-3098
FAX: (916) 278-3071
lrbrown@usgs.gov

Glenn County
Board of Supervisors
P. O. Box 391, 526 West Sycamore Street
Willows, CA 95988

15 May 2000

Dear Ms. or Sir:

This letter is to inform your county that I have submitted a proposal to the CALFED Program in response to the Ecosystem Restoration Program, 2001 Project Solicitation Package. The proposal is titled, "Using Benthic Macroinvertebrate Communities for Assessment of Adaptive Management Actions in Streams Supporting Anadromous Salmonids." This proposal is for research/monitoring only and, if funded, may include one or more sampling sites on streams or rivers in your county. If the proposal is selected for funding, I will notify you by a second letter, which will include a copy of the proposal. After that I will be selecting sampling sites for the study. If any sampling sites occur in your county I will contact the appropriate public agencies or private landowners to obtain permission to access the site before any sampling takes place. Please feel free to contact me if you would like any additional information at this time.

Sincerely,

Larry R. Brown

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U.S. Geological Survey
Placer Hall
6000 J Street
Sacramento, CA 95819-6129

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e-mail: lrbrown@usgs.gov

United States Department of the Interior

U.S. GEOLOGICAL SURVEY

Placer Hall, 6000 J Street
Sacramento, California
(916) 278-3098
FAX: (916) 278-3071
lrbrown@usgs.gov

Mariposa County
County Courthouse
P.O. Box 784
Mariposa, CA 95338-0784

15 May 2000

Dear Ms. or Sir:

This letter is to inform your county that I have submitted a proposal to the CALFED Program in response to the Ecosystem Restoration Program, 2001 Project Solicitation Package. The proposal is titled, "Using Benthic Macroinvertebrate Communities for Assessment of Adaptive Management Actions in Streams Supporting Anadromous Salmonids." This proposal is for research/monitoring only and, if funded, may include one or more sampling sites on streams or rivers in your county. If the proposal is selected for funding, I will notify you by a second letter, which will include a copy of the proposal. After that I will be selecting sampling sites for the study. If any sampling sites occur in your county I will contact the appropriate public agencies or private landowners to obtain permission to access the site before any sampling takes place. Please feel free to contact me if you would like any additional information at this time.

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U.S. Geological Survey
Placer Hall
6000 J Street
Sacramento, CA 95819-6129

Phone: 916-278-3098
FAX: 916-278-3071
e-mail: lrbrown@usgs.gov

United States Department of the Interior

U.S. GEOLOGICAL SURVEY

Placer Hall, 6000 J Street
Sacramento, California
(916) 278-3098
FAX: (916) 278-3071
lrbrown@usgs.gov

Madera County
County Courthouse
209 W. Yosemite Avenue
Madera, CA 93637-3534

15 May 2000

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This letter is to inform your county that I have submitted a proposal to the CALFED Program in response to the Ecosystem Restoration Program, 2001 Project Solicitation Package. The proposal is titled, "Using Benthic Macroinvertebrate Communities for Assessment of Adaptive Management Actions in Streams Supporting Anadromous Salmonids." This proposal is for research/monitoring only and, if funded, may include one or more sampling sites on streams or rivers in your county. If the proposal is selected for funding, I will notify you by a second letter, which will include a copy of the proposal. After that I will be selecting sampling sites for the study. If any sampling sites occur in your county I will contact the appropriate public agencies or private landowners to obtain permission to access the site before any sampling takes place. Please feel free to contact me if you would like any additional information at this time.

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Larry R. Brown

Larry R. Brown
U.S. Geological Survey
Placer Hall
6000 J Street
Sacramento, CA 95819-6129

Phone: 916-278-3098
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United States Department of the Interior

U.S. GEOLOGICAL SURVEY

Placer Hall, 6000 J Street
Sacramento, California
(916) 278-3098
FAX: (916) 278-3071
lrbrown@usgs.gov

Merced County
Board of Supervisors Merced County
2222 M Street
Merced, CA 95340

15 May 2000

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This letter is to inform your county that I have submitted a proposal to the CALFED Program in response to the Ecosystem Restoration Program, 2001 Project Solicitation Package. The proposal is titled, "Using Benthic Macroinvertebrate Communities for Assessment of Adaptive Management Actions in Streams Supporting Anadromous Salmonids." This proposal is for research/monitoring only and, if funded, may include one or more sampling sites on streams or rivers in your county. If the proposal is selected for funding, I will notify you by a second letter, which will include a copy of the proposal. After that I will be selecting sampling sites for the study. If any sampling sites occur in your county I will contact the appropriate public agencies or private landowners to obtain permission to access the site before any sampling takes place. Please feel free to contact me if you would like any additional information at this time.

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U.S. Geological Survey
Placer Hall
6000 J Street
Sacramento, CA 95819-6129

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United States Department of the Interior

U.S. GEOLOGICAL SURVEY

Placer Hall, 6000 J Street
Sacramento, California
(916) 278-3098
FAX: (916) 278-3071
lrbrown@usgs.gov

Nevada County
Nevada County Board of Supervisors
Eric Rood Administrative Center
950 Maidu Avenue
Nevada City, CA 95959

15 May 2000

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This letter is to inform your county that I have submitted a proposal to the CALFED Program in response to the Ecosystem Restoration Program, 2001 Project Solicitation Package. The proposal is titled, "Using Benthic Macroinvertebrate Communities for Assessment of Adaptive Management Actions in Streams Supporting Anadromous Salmonids." This proposal is for research/monitoring only and, if funded, may include one or more sampling sites on streams or rivers in your county. If the proposal is selected for funding, I will notify you by a second letter, which will include a copy of the proposal. After that I will be selecting sampling sites for the study. If any sampling sites occur in your county I will contact the appropriate public agencies or private landowners to obtain permission to access the site before any sampling takes place. Please feel free to contact me if you would like any additional information at this time.

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U.S. Geological Survey
Placer Hall
6000 J Street
Sacramento, CA 95819-6129

Phone: 916-278-3098
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United States Department of the Interior

U.S. GEOLOGICAL SURVEY

Placer Hall, 6000 J Street
Sacramento, California
(916) 278-3098
FAX: (916) 278-3071
lrbrown@usgs.gov

Placer County
175 Fulweiler Ave.
Auburn, CA 95603

15 May 2000

Dear Ms. or Sir:

This letter is to inform your county that I have submitted a proposal to the CALFED Program in response to the Ecosystem Restoration Program, 2001 Project Solicitation Package. The proposal is titled, "Using Benthic Macroinvertebrate Communities for Assessment of Adaptive Management Actions in Streams Supporting Anadromous Salmonids." This proposal is for research/monitoring only and, if funded, may include one or more sampling sites on streams or rivers in your county. If the proposal is selected for funding, I will notify you by a second letter, which will include a copy of the proposal. After that I will be selecting sampling sites for the study. If any sampling sites occur in your county I will contact the appropriate public agencies or private landowners to obtain permission to access the site before any sampling takes place. Please feel free to contact me if you would like any additional information at this time.

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U.S. Geological Survey
Placer Hall
6000 J Street
Sacramento, CA 95819-6129

Phone: 916-278-3098
FAX: 916-278-3071
e-mail: lrbrown@usgs.gov

United States Department of the Interior

U.S. GEOLOGICAL SURVEY

Placer Hall, 6000 J Street
Sacramento, California
(916) 278-3098
FAX: (916) 278-3071
lrbrown@usgs.gov

Sacramento County
County of Sacramento
700 H Street Suite 2450
Sacramento, CA 95814

15 May 2000

Dear Ms. or Sir:

This letter is to inform your county that I have submitted a proposal to the CALFED Program in response to the Ecosystem Restoration Program, 2001 Project Solicitation Package. The proposal is titled, "Using Benthic Macroinvertebrate Communities for Assessment of Adaptive Management Actions in Streams Supporting Anadromous Salmonids." This proposal is for research/monitoring only and, if funded, may include one or more sampling sites on streams or rivers in your county. If the proposal is selected for funding, I will notify you by a second letter, which will include a copy of the proposal. After that I will be selecting sampling sites for the study. If any sampling sites occur in your county I will contact the appropriate public agencies or private landowners to obtain permission to access the site before any sampling takes place. Please feel free to contact me if you would like any additional information at this time.

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U.S. Geological Survey
Placer Hall
6000 J Street
Sacramento, CA 95819-6129

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United States Department of the Interior

U.S. GEOLOGICAL SURVEY

Placer Hall, 6000 J Street
Sacramento, California
(916) 278-3098
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lrbrown@usgs.gov

San Joaquin County
Board of Supervisors and Clerk of the Board
Courthouse, Room 701
222 East Weber Avenue
Stockton, CA 95202

15 May 2000

Dear Ms. or Sir:

This letter is to inform your county that I have submitted a proposal to the CALFED Program in response to the Ecosystem Restoration Program, 2001 Project Solicitation Package. The proposal is titled, "Using Benthic Macroinvertebrate Communities for Assessment of Adaptive Management Actions in Streams Supporting Anadromous Salmonids." This proposal is for research/monitoring only and, if funded, may include one or more sampling sites on streams or rivers in your county. If the proposal is selected for funding, I will notify you by a second letter, which will include a copy of the proposal. After that I will be selecting sampling sites for the study. If any sampling sites occur in your county I will contact the appropriate public agencies or private landowners to obtain permission to access the site before any sampling takes place. Please feel free to contact me if you would like any additional information at this time.

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United States Department of the Interior

U.S. GEOLOGICAL SURVEY

Placer Hall, 6000 J Street
Sacramento, California
(916) 278-3098
FAX: (916) 278-3071
lrbrown@usgs.gov

Shasta County
Shasta County Board of Supervisors
1815 Yuba St., Suite 1
Redding, CA 96001

15 May 2000

Dear Ms. or Sir:

This letter is to inform your county that I have submitted a proposal to the CALFED Program in response to the Ecosystem Restoration Program, 2001 Project Solicitation Package. The proposal is titled, "Using Benthic Macroinvertebrate Communities for Assessment of Adaptive Management Actions in Streams Supporting Anadromous Salmonids." This proposal is for research/monitoring only and, if funded, may include one or more sampling sites on streams or rivers in your county. If the proposal is selected for funding, I will notify you by a second letter, which will include a copy of the proposal. After that I will be selecting sampling sites for the study. If any sampling sites occur in your county I will contact the appropriate public agencies or private landowners to obtain permission to access the site before any sampling takes place. Please feel free to contact me if you would like any additional information at this time.

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Placer Hall
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Sacramento, CA 95819-6129

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United States Department of the Interior

U.S. GEOLOGICAL SURVEY

Placer Hall, 6000 J Street
Sacramento, California
(916) 278-3098
FAX: (916) 278-3071
lrbrown@usgs.gov

Stanislaus County
Board of Supervisors
1010 10th street
Suite 6500
Modesto, CA 93554

15 May 2000

Dear Ms. or Sir:

This letter is to inform your county that I have submitted a proposal to the CALFED Program in response to the Ecosystem Restoration Program, 2001 Project Solicitation Package. The proposal is titled, "Using Benthic Macroinvertebrate Communities for Assessment of Adaptive Management Actions in Streams Supporting Anadromous Salmonids." This proposal is for research/monitoring only and, if funded, may include one or more sampling sites on streams or rivers in your county. If the proposal is selected for funding, I will notify you by a second letter, which will include a copy of the proposal. After that I will be selecting sampling sites for the study. If any sampling sites occur in your county I will contact the appropriate public agencies or private landowners to obtain permission to access the site before any sampling takes place. Please feel free to contact me if you would like any additional information at this time.

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Sacramento, CA 95819-6129

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United States Department of the Interior

U.S. GEOLOGICAL SURVEY

Placer Hall, 6000 J Street
Sacramento, California
(916) 278-3098
FAX: (916) 278-3071
lrbrown@usgs.gov

Sutter County
1160 Civic Center Blvd., Suite B
Yuba City, CA 95993

15 May 2000

Dear Ms. or Sir:

This letter is to inform your county that I have submitted a proposal to the CALFED Program in response to the Ecosystem Restoration Program, 2001 Project Solicitation Package. The proposal is titled, "Using Benthic Macroinvertebrate Communities for Assessment of Adaptive Management Actions in Streams Supporting Anadromous Salmonids." This proposal is for research/monitoring only and, if funded, may include one or more sampling sites on streams or rivers in your county. If the proposal is selected for funding, I will notify you by a second letter, which will include a copy of the proposal. After that I will be selecting sampling sites for the study. If any sampling sites occur in your county I will contact the appropriate public agencies or private landowners to obtain permission to access the site before any sampling takes place. Please feel free to contact me if you would like any additional information at this time.

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U.S. Geological Survey
Placer Hall
6000 J Street
Sacramento, CA 95819-6129

Phone: 916-278-3098
FAX: 916-278-3071
e-mail: lrbrown@usgs.gov

United States Department of the Interior

U.S. GEOLOGICAL SURVEY

Placer Hall, 6000 J Street
Sacramento, California
(916) 278-3098
FAX: (916) 278-3071
lrbrown@usgs.gov

Tehama County
County Courthouse
P.O. Box 250
Red Bluff, CA 96080-0250

15 May 2000

Dear Ms. or Sir:

This letter is to inform your county that I have submitted a proposal to the CALFED Program in response to the Ecosystem Restoration Program, 2001 Project Solicitation Package. The proposal is titled, "Using Benthic Macroinvertebrate Communities for Assessment of Adaptive Management Actions in Streams Supporting Anadromous Salmonids." This proposal is for research/monitoring only and, if funded, may include one or more sampling sites on streams or rivers in your county. If the proposal is selected for funding, I will notify you by a second letter, which will include a copy of the proposal. After that I will be selecting sampling sites for the study. If any sampling sites occur in your county I will contact the appropriate public agencies or private landowners to obtain permission to access the site before any sampling takes place. Please feel free to contact me if you would like any additional information at this time.

Sincerely,

Larry R. Brown

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U.S. Geological Survey
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Sacramento, CA 95819-6129

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Tuolumne County
County Courthouse
2 South Green Street
Sonora, CA 95370-4618

15 May 2000

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This letter is to inform your county that I have submitted a proposal to the CALFED Program in response to the Ecosystem Restoration Program, 2001 Project Solicitation Package. The proposal is titled, "Using Benthic Macroinvertebrate Communities for Assessment of Adaptive Management Actions in Streams Supporting Anadromous Salmonids." This proposal is for research/monitoring only and, if funded, may include one or more sampling sites on streams or rivers in your county. If the proposal is selected for funding, I will notify you by a second letter, which will include a copy of the proposal. After that I will be selecting sampling sites for the study. If any sampling sites occur in your county I will contact the appropriate public agencies or private landowners to obtain permission to access the site before any sampling takes place. Please feel free to contact me if you would like any additional information at this time.

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Sacramento, California
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Yolo County
625 Court Street, Room 204
Woodland, CA 95695

15 May 2000

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This letter is to inform your county that I have submitted a proposal to the CALFED Program in response to the Ecosystem Restoration Program, 2001 Project Solicitation Package. The proposal is titled, "Using Benthic Macroinvertebrate Communities for Assessment of Adaptive Management Actions in Streams Supporting Anadromous Salmonids." This proposal is for research/monitoring only and, if funded, may include one or more sampling sites on streams or rivers in your county. If the proposal is selected for funding, I will notify you by a second letter, which will include a copy of the proposal. After that I will be selecting sampling sites for the study. If any sampling sites occur in your county I will contact the appropriate public agencies or private landowners to obtain permission to access the site before any sampling takes place. Please feel free to contact me if you would like any additional information at this time.

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Yuba County
County Courthouse
215 Fifth Street
Marysville, CA 95901-5737

15 May 2000

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